

### 3. *Pareiasaurian Studies.*

Part I.—*An Attempt at a Classification of the Pareiasauria based on Skull Features.*—By S. H. HAUGHTON, B.A., D.Sc., Hon. Curator, and L. D. BOONSTRA, M.Sc., Assistant in Palaeontology.

THE identification of Pareiasaurian material from the Karroo Beds of South Africa offers certain peculiar difficulties, and hitherto very few attempts have been made to classify the various examples which have been collected, and only one attempt has been made to divide the known species into clearly defined genera. This was done by Watson, who based his classification on the material in the British Museum collection and on one skeleton in the South African Museum, and endeavoured to separate the following Pareiasaurian genera: *Pareiasaurus*, Owen; *Propappus*, Seeley; *Anthodon*, Owen; *Bradysaurus*, Watson; and *Embrithosaurus*, Watson. Watson's classification was not accepted by Broom, who has subsequently described new forms under the generic name *Pareiasaurus* on the grounds of established usage, whilst recognising a necessity for further subdivision, and suggesting that Watson's generic names should be relegated to the status of sub-genera.

One of the difficulties which faces the student of Pareiasaurian systematics is the variability shown by individual skulls, a variability which, as Broom has pointed out, might almost induce the worker to make each skull the type of a separate species. This variability is, in large part, due to post-mortem deformation, and the writers of this paper have attempted to use as a basis of classification features which are the least likely to be affected by such changes as lateral or dorso-ventral compression. The number of specimens we have been enabled to examine is far greater than any other worker has studied, and we feel that we are justified in putting forward this scheme of classification as a basis for future study and criticism.

The classification is based largely on the features of the skull and lower jaw. Where possible, it has been checked by reference to the characters of the postcranial skeleton; and the result must be taken as a basis for a much fuller description of all the material we have

studied. That material consists mainly of the large collection of Pareiasauria which the South African Museum has amassed by collection and by donation; but the senior author has also had the opportunity of examining critically the historic specimens in the British Museum and the type of *P. acutirostris* in the Albany Museum. We are also indebted to Dr. R. Broom for some sketches and notes upon the somewhat incompletely described species *whaitsi* and *strubeni*, whose types are now in the American Museum of Natural History.

*Teeth.*—As is well known, the teeth of Pareiasauria are single-rooted, and have crowns which are broader than thick and furnished with a series of marginal cusps. Examination of the dental series of any single skull will show that, although the anterior teeth may differ from the posterior teeth in actual and relative dimensions, the teeth throughout the series usually agree with one another in the nature and number of the cusps.\* A study of the cusping of a series of skulls shows, however, that an obvious distinction exists between forms like *serridens*, *serrarius*, *peringueyi*, and *omocratus* on the one hand (with numerous cusps arranged round the edge in a regular segment of a circle), and *baini* and *bombidens* on the other (with a few cusps), with *schwarzi* occupying a somewhat intermediate position.

The actual number of teeth present seems to be, within certain limits, a function of the age of the skull; and any scheme of classification which takes cognisance of the number of teeth can only be based, therefore, upon the space occupied by a complete series, especially in view of the fact that the dimensions of the anterior teeth usually differ appreciably from those of the posterior ones.

*Top of Skull.*—Post-mortem compression may have the effect of masking the true form of the snout of a skull or alter the relation of the descending cheek to the rest of the skull; but, beyond a twisting, whose presence can easily be detected and whose amount can be estimated, it can have little effect upon the broad, flat plate of bones which forms the dorsal interorbital and postorbital surface. We have, therefore, taken into consideration the shape of this surface, defining that shape in terms of the ratio between the interorbital width and that between the centres of the prominent tabular bosses, designating the latter for convenience the tabular width. This has supplied a ready means of distinguishing three groups among the skulls having teeth with few cusps—viz. those whose interorbital width is greater than, approximately equal to, or less than the tabular width.

\* An exception to this occurs in skulls placed in the new genus *Nochelesaurus*.

*The Cheek.*—Examination of a well-preserved skull such as that of *Pareiasuchus peringueyi* shows that, although the two cheeks are generally alike, there are minute differences between the sculpture and arrangement of the bosses on the two sides. The hinder border of the cheek is furnished with a series of bosses which, in different species, differ in prominence. In some species, too, the cheek is obviously long; in others, comparatively short. This last difference we have used in our classification, estimating the “length” by the ratio between the distance between the top of the tabular boss and the lowest corner of the cheek, and that between the hinder border of the orbit and the middle of the cheek.

*Basis of Classification.*—The large and earliest Pareiasaurs have teeth with elongate crowns carrying a few marginal cusps; the Pareiasauria from the upper half of the Lower Beaufort Beds have broad, shortened teeth with somewhat numerous cusps. We have, therefore, made our primary subdivision on the nature of the teeth, recognising at the same time that forms in one of the new subdivisions may be actually closely allied to forms in another. The other factors we have used in defining genera and species are—(a) the shape of the top of the skull, (b) the shape of the snout, (c) the depth and nature of the cheek, and (d) the shape of the lower jaw. The classification thus obtained is admittedly an artificial one; but we believe that by its use as a basis for the identification of species it will be possible ultimately to arrive at some phylogenetic classification within the group, linking together successive species in the time-scale.

## DIVISION A.

Forms having teeth with few cusps (less than 9) arranged irregularly round the crown.

### SUBDIVISION Aa.

Forms with interorbital width appreciably less than the “tabular width.”

#### 1. Genus BRADYSAURUS, Watson.

Snout broad and rounded. Cheek shallow. Six cusps on each tooth.

#### *Bradysaurus bairdi* Seeley.

Posterior border of cheek fairly smooth.

To this species we assign the following specimens :—

- a. The type in the British Museum, from De Bad, Prince Albert Division.
- b. Skull and skeleton 4347 in S. African Museum, from Abrahams Kraal, Prince Albert Division.
- c. Skull and skeleton 5127 in S. African Museum, from Leeuw Rivier, Beaufort West Division.
- d. Skeleton 3533 in S. African Museum, from Hottentots River, Beaufort West Division.
- e. Partial skull and skeleton 4999 in S. African Museum, from Grootfontein, Prince Albert Division.
- f. Skull in Tübingen Geol.-paläontolog. Institut, from Abrahams Kraal, Prince Albert Division.

*Bradysaurus seeleyi* sp. nov.

Posterior border of cheek with well-defined bosses.

This species is based upon the two specimens in the British Museum which were described by Seeley as *Pareiasaurus bombidens*. The one of these which may be looked upon as the type of the new species is No. 49426, and came from Palmietfontein; the other (R1970) is known as the Tamboer specimen.

*B. bombidens* was founded by Owen on a very fragmentary maxilla and lower jaw—a very unsatisfactory type which cannot accurately be placed in our classification; the teeth of *seeleyi*, however, seem to be relatively broader and flatter than in the type of *bombidens*.

To this species, too, we assign the S. African Museum skeleton No. 5624, from Groot Kruidfontein, Prince Albert Division.

*Bradysaurus vanderbyli* sp. nov.

Posterior border of cheek very smooth.

The type of this new species is a very large skull and lower jaw—No. 3718 in the S. African Museum collection—from Abrahams Kraal, Prince Albert Division. To the species we also assign No. 6242 (S. Afr. Mus.), from Zwarts Siding, Prince Albert Division, and No. 8941 (S. Afr. Mus.), from Mynhardts Kraal, Beaufort West Division.

2. Genus BRADYSUCHUS, nov.

Snout pointed. Cheek deep. Cusps unknown.

*Bradysuchus whaitsi* (Broom).

Posterior border of cheek with bosses. Large tabular bosses. Median nasal boss. Two bosses on lower border of angular.

We have not seen the type and only known specimen, which is a skull and lower jaw from Fraserburg Road, now in the American Museum of Natural History, but Dr. Broom has favoured us with a sketch of the top of the skull.

#### SUBDIVISION Ab.

Forms with interorbital width approximately equal to the "tabular width."

#### 3. Genus NOCHELESAURUS, nov.

Snout rather pointed. Cheek deep. Teeth massive. Number of cusps 6 to 8.

##### *Nochelesaurus strubeni* (Broom).

Posterior border of cheek without bosses. Single median nasal boss. Deep, short lower jaw with large angular boss.

The type is a lower jaw from Abrahams Kraal, now in the American Museum of Natural History. We have assigned to the species, by comparison of the lower jaws, a complete skull and lower jaw from Blaauwkranz, Prince Albert Division (No. 5019 in the S. African Museum), and another specimen (No. 5590, S. African Museum) from the type locality.

##### *Nochelesaurus alexanderi* sp. nov.

Snout less pointed than in *strubeni*. Posterior border of cheek with strong bosses. Skull heavily ornamented.

Type.—No. 6239 in S. African Museum, from Boesmanskop, Beaufort West Division. This species is named in honour of Dr. A. L. du Toit.

#### 4. Genus DOLICHOPAREIA, nov.

Snout very pointed. Cheek deep.

##### *Dolichopareia angusta* sp. nov.

Posterior border of cheek with strong bosses. Skull heavily ornamented. Two nasal bosses close together with possibly a median boss. Deep jaw with large angular boss.

The type is a skull and lower jaw from Boesmanskop, Beaufort West Division (No. 6238 in S. African Museum). No. 3717 (S. African

Museum), from Leeuw Rivier, Beaufort West Division, is also assigned to this species.

SUBDIVISION Ac.

Forms with interorbital width appreciably greater than "tabular width."

5. Genus KOALEMASAURUS, nov.

Orbit in anterior half of skull.

*Koalemasaurus acutirostris* (Broom).

Cheek broad and low. Posterior border of cheek with low bosses. Angular boss low.

Type.—Skull and lower jaw from Hottentots River, Beaufort West Division, in the Albany Museum, Grahamstown.

6. Genus BRACHYPAREIA, nov.

Orbit not in anterior half of skull. Cheek broad and low.

*Brachypareia rogersi* (Broom).

Cheek rather smooth. Snout rounded.

The type consists of part of a postcranial skeleton without skull, from Hoedemakers Kraal, Prince Albert Division. The South African Museum contains an almost complete skeleton (No. 5012), from Abrahams Kraal, Prince Albert Division, in which the limb-bones and vertebrae agree very closely with those of the type. This is therefore taken as a neotype, and the skull-characters described from it.

*Brachypareia watsoni*, sp. nov.

Cheek with fairly marked bosses and rugose surface. Snout pointed.

Type.—No. 6240 (S. African Museum), from Abrahams Kraal, Prince Albert Division.

7. Genus PLATYOROPHA, nov.

Orbit not in anterior half of skull. Cheek narrow and deep.

*Platyoropha broomi*, sp. nov.

Posterior border of cheek thin, with bosses in lower half only. Snout very broad and rounded.

Type.—Skull No. 5002 (S. African Museum), from Vogelfontein, Prince Albert Division.

DIVISION B.

Forms having teeth with 9 cusps arranged irregularly around border of crown.

SUBDIVISION Ba.

Forms with interorbital width approximately equal to the "tabular width."

8. Genus *EMBRITHOSAURUS*, Watson.

Snout rather pointed. Cheek deep. Teeth with 3 anterior and 3 posterior cusps.

*Embrithosaurus schwarzi* Watson.

Posterior border of cheek with pronounced bosses. Two nasal bosses.

Type.—Complete skeleton in S. African Museum, from Hoogeveld, Lot A, Prince Albert Division.

DIVISION C.

Forms having teeth with 9 or more cusps arranged regularly around edge of crown.

SUBDIVISION Ca.

Top of skull narrow.

9. Genus *ANTHODON*, Owen.

Interorbital width small. Skull small. Cheek deep.

*Anthodon serrarius* Owen.

Surface of skull smooth.

The type specimen is an imperfect skull and anterior vertebrae (Brit. Mus., No. 47337), from Stylkranz, Graaff Reinet Division.

The S. African Museum possesses a weathered skull (No. 4020), from Dalham, Graaff Reinet Division, from which full details of the palate and basicranium can be obtained. The postcranial skeleton is hitherto unknown.

SUBDIVISION Cb.

Top of skull broad.

10. GENUS *PAREIASAURUS*, Owen.

Skull pointed. Cheeks very deep. Ilium strongly inclined forwards. Ischium short.

*Pareiasaurus serridens* Owen.

Crowns of teeth quadrangular in lateral view and with pronounced lingual ingulum.

The type consists of the cast of a skull, a fragmentary lower jaw, pelvis, scapula, dorsal vertebrae, and scutes (Brit. Mus. No. R4063), from Blinkwater, Fort Beaufort Division. No other specimen is known, but it is highly probable that *Pareiasaurus russouwi* Seeley is synonymous with *serridens*. The type of *russouwi* is a right upper jaw and dentary with angular boss, from Klipfontein, Fraserburg Division (Brit. Mus. No. R1996). In its dimensions and the nature of its teeth it agrees closely with *serridens*.

11. GENUS *PAREIASUCHUS* Broom and Haughton.

Snout rounded. Cheek deep and rugose. Ilium as in *Pareiasaurus*. Ischium long.

*Pareiasuchus peringueyi* Broom and Haughton.

Cheek very rugose with massive boss at genal angle. Massive shallow angular boss.

The type is a complete skeleton in the S. African Museum, from Dunedin, Beaufort West Division.

*Pareiasuchus nasicornis* sp. nov.

Cheek less rugose than in *peringueyi*, with genal angle pointing slightly backwards. Nasal bosses very prominent; other bosses on top of skull reduced. Palate shorter than in *peringueyi*. Horn-like angular boss.



The type is a crushed but almost complete skeleton in the S. African Museum (No. 3016), from Graaff Reinet.

SUBDIVISION Cc.

Skull unknown.

12. Genus PROPAPPUS, Seeley.

Ilium not much inclined forwards. Ischium short.

*Propappus omocratus* Seeley.

The type is a partial skeleton, without skull, in the British Museum (R4064), from East Brak River, Fort Beaufort Division. There is in the S. African Museum the specimen described under this name by Broom, from Welgevonden, Graaff Reinet Division. In the dimension and shape of the limb-bones and vertebrae the two specimens agree closely enough to suggest that Broom was correct in his assignation of the Welgevonden specimen. If so, then *omocratus* is peculiar in that it possesses two horn-like knobs on the angular, of which the posterior is the larger, thereby agreeing with *Bradysuchus whaitsi* only among known forms.

*Propappus parvus* Haughton.

This species is based upon a pelvis, some vertebrae, and some dermal ossicles, and is mainly characterised by the short upstanding ilium and the very large ischial tuberosity.